Claims

1. Method for vacuum-coating a substrate using a plasma CVD method, in which a substrate voltage is applied to the substrate during the coating in order to control the ion bombardment, characterized in that substrate voltage (US) and coating plasma (20) are produced independently of one another, and the substrate voltage (US) is modified during the coating.

2. Method according to claim 1, characterized in that the substrate voltage (US) is a direct voltage pulsed in bipolar fashion, having a frequency of 0.1 kHz to 10 MHz, in particular 1-100 kHz.

3. Method according to claim 2, characterized in that the positive and negative pulses of the substrate voltage (US) can be adjusted independently of one another in their chronological length and/or height.

4. Method according to claim 2, characterized in that a direct voltage is superposed on the substrate voltage (US).

5. Method according to claim 2, characterized in that voltage-free pause times of 0 to 1 msec, in particular 2 to 100 μsec, between the negative and positive pulses of the substrate voltage (US).

6. Method according to claim 5, characterized in that the pause time after a negative pulse is shorter than the pause time after a positive pulse.

7. Method according to claim 1, characterized in that during the coating gases of different types and in various combinations are added.

8. Method according to claim 6, characterized in that the added gases are conducted through the plasma source (18) or are introduced near the source.

9. Method according to claim 6, characterized in that (C_xH_y), in particular (C_2H_2, CH_4), silanes and siloxanes, in particular (SiH_4) or HMDS and derivates, noble gases, metallo-organic compounds, or a combination of these gases is used as a reactive gas.

10. Device for the execution of the method according to claim 1, having a vacuum recipient (12), a bearing device (11) for the reception of substrates (10) to be coated, means (15 to 19) for producing a plasma (20) in the interior (21) of the recipient, characterized by a device (13), controllable separately from the plasma production means (15 to 19), for producing a substrate voltage (US) that is applied to the substrates (10) to be coated.

11. Device according to claim 10, characterized in that for the production of the plasma (20) a microwave source (15), a sputter cathode (17), a hollow cathode (18), a high-frequency source or an arrangement for producing a high-current arc (19) are used.

12. Device according to claim 10, characterized in that the voltage supply (13) is a bias power supply unit that is pulsed in bipolar fashion.

13. Device according to claim 10, characterized in that it is operated as a pass-through arrangement, with substrates that are unmoved, are moved in uniform fashion, or are moved in pulsed fashion.

14. Device according to claim 10, characterized in that the

means (15, 17, 18, 19) for producing the plasma (20) are operated in pulsed fashion.

15. Method according to one of claims 1 to 9, using the device according to one of claims 10 to 14 for the manufacture of a carbon layer, in particular of an amorphous carbon layer (a-C:H).

16. Method according to one of claims 1 to 9, using the device according to one of claims 10 to 14 for the manufacture of a silicon layer, in particular of an amorphous silicon layer (a-Si:H).

17. Method according to one of claims 1 to 9, using the device according to one of claims 10 to 14 for the manufacture of a multilayer coating structure made up of a layer containing metal for imparting adhesion and an amorphous carbon layer applied thereon, the transitions to the adhesion-imparting layers being realized as gradients over at least 1/5 of the individual layer thicknesses.

18. Method according to one of claims 1 to 9, using the device according to one of claims 10 to 14 for the deposition of a layer system containing silicon, boron, nitrogen, oxygen, carbon, a metal, or a combination of these elements.

19. Method according to one of claims 1 to 9, using a device according to one of claims 10 to 14 for the manufacture of a multilayer structure of alternating individual layers.

20. Multilayer structure made up of alternating hard material individual layers and carbon or silicon individual layers.

21. Multilayer structure according to claim 20, characterized in that the carbon layer is made up of amorphous carbon containing hydrogen (a-C:H in the following), amorphous hydrogen-free carbon (a-C), carbon (containing hydrogen or hydrogen-free) containing silicon, or carbon (containing hydrogen or hydrogen-free) containing metal (C-(MeC)), the metal being selected from the hard secondary group metals.

22. Multilayer structure according to claim 20, characterized in that the silicon layer is made up of amorphous silicon containing hydrogen (a-Si:H in the following), amorphous hydrogen-free silicon (a-Si), silicon (containing hydrogen or hydrogen-free) containing carbon, or silicon (containing hydrogen or hydrogen-free) containing metal (Si-(MeSi)).

23. Multilayer structure according to one of claims 20 to 22, characterized in that the hard material layer is made up of a metal (Me in the following), a metal compound, carbon containing metal carbide (C-(MeC)), silicon containing metal silicide (Si-(MeSi)), or mixtures of at least two of the named materials.

24. Multilayer structure according to claim 23, characterized in that the metal is selected from the group tungsten (W), chromium (Cr), titanium (Ti), niobium (Nb) and molybdenum (Mo).

25. Multilayer structure according to claim 23, characterized in that the metal compound is a metal carbide (MeC), a metal nitride (MeN), a metal silicide (MeSi), a metal carbonitride (MeCN)), a metal carbosilicide (Me(CSi)) or a metal siliconitride (Me(SiN)).

26. Multilayer structure according to one of claims 20 to 25, characterized in that the individual layers are made up of one type or several types of the hard material layer and one type or several types of the carbon or the silicon layer.

27. Multilayer structure according to claim 26, characterized in that the individual layers are made up of one type of the hard material layer and one type of the carbon or the silicon layer.

28. Multilayer structure according to one of claims 20 to 27, characterized in that the thicknesses of the individual layers are between approximately 1 and approximately 10 nm, and preferably between approximately 2 and approximately 5 nm.

29. Multilayer structure according to one of claims 20 to 28, characterized in that the overall thickness of the structure is between approximately 1 and approximately 10 μm, and preferably between approximately 1 and approximately 4 μm.

30. Multilayer structure according to one of claims 23 to 29, characterized in that the hard material layer is made of Me, MeC, MeN, MeSi, Me(CN), Me(CSi), or Me(SiN), and the carbon layer is made of a-C:H or a-C.

31. Multilayer structure according to one of claims 23 to 29, characterized in that it is made up of alternating C-(WC) layers and a-C:H layers.

32. Multilayer structure according to one of claims 23 to 29, characterized in that it is made up of alternating MeC layers and C-(MeC) layers.

33. Multilayer structure according to one of claims 23 to 28, characterized in that the hard material layer is made of Me, MeC, MeN, MeSi, Me(CN), Me(CSi), or Me(SiN), and the silicon layer is made of a-Si:H or a-Si.

34. Multilayer structure according to one of claims 20 to 33, characterized in that the individual layers additionally contain at least one element from the group silicon, boron, nitrogen, oxygen, carbon, and a metal, under the precondition that boron and carbon are not simultaneously present in them.

35. Multilayer structure according to one of claims 20 to 34, characterized in that a tool, in particular a machining tool or non-cutting shaping tool, is coated therewith.